

Observations on the biology of the Ethiopian Bush Crow *Zavattariornis stresemanni*

Kai Gedeon

Observations sur la biologie du Corbin de Stresemann *Zavattariornis stresemanni*. Le Corbin de Stresemann *Zavattariornis stresemanni* possède une aire de répartition extrêmement réduite au sud de l'Éthiopie et sa survie est menacée par la modification de son habitat. Il figure comme Menacé d'extinction sur la liste rouge de l'UICN, et sa biologie demeure peu connue. Pendant des travaux sur le terrain dans la zone de Yabello, en février–mars 2005, de nouvelles données ont été collectées, en particulier concernant ses expressions faciales, son comportement social et ses exigences en matière d'habitat. L'espèce est capable de lisser les plumes autour et derrière l'œil, exposant ainsi un triangle de peau nue roseâtre, l'iris normalement rond se rétrécissant verticalement en même temps. Il s'agit apparemment d'une forme d'expression, inconnue chez d'autres espèces d'oiseaux, qui est utilisée uniquement dans certaines circonstances (par exemple en cas de menace ou d'excitation). Le répertoire de comportements de l'espèce comprend le nourrissage mutuel et la toilette mutuelle, tout deux observés fréquemment. Le comportement lors de la recherche de nourriture semble indiquer que la présence d'une couche de terre lâche et relativement profonde, contenant une source de nourriture préférée (des larves de coléoptères), est cruciale. Ceci expliquerait tant la concentration de couples nicheurs de Corbins dans des peuplements éclaircis d'*Acacia* que sa grande densité près de champs fraîchement labourés, et est probablement la raison pour laquelle la zone occupée par *Zavattariornis* est aussi restreinte.

Summary. Ethiopian Bush Crow *Zavattariornis stresemanni* has an extremely small range in southern Ethiopia and its survival is threatened by habitat change. It is treated as Endangered in the IUCN Red Data List, and very little is known of its biology. During field work in the Yabello region in February–March 2005 new data were collected, particularly concerning its comportment, social behaviour and habitat requirements. The bird was found to have the remarkable ability of displacing the feathers around and behind the eye, to expose a naked, flesh-coloured triangle of skin, whilst the otherwise round iris was vertically narrowed. This appeared to be a form of expression used only in particular contexts (e.g. when threatened or aroused). It is unknown in any other bird species. The species' behavioural repertoire includes allofeeding and allopreening, both of which were frequently observed. Feeding behaviour suggests that a crucial habitat requirement is the presence of loosely packed, relatively deep soil with the associated presence of a preferred food resource (beetle larvae). This would explain both the concentration of bush crow breeding pairs in thinned-out *Acacia* stands and its high density adjacent to freshly ploughed fields, and is probably the reason why the area inhabited by *Zavattariornis* is so restricted.

The discovery of Ethiopian Bush Crow *Zavattariornis stresemanni* was one of the most remarkable ornithological events of the 20th century in Africa. It occurred during the era of the Italian colonial occupation of north-east Africa. An expedition from the Zoological Institute of the Royal University in Rome, led by Edoardo Zavattari, travelled through the south Ethiopian Borana territory in 1937 and collected a single bush crow. It was described the following year by Moltoni (1938), who allocated the species to the Corvidae. However, as the bird did not resemble

any of the known representatives of this family in the Old World, the author erected a new genus for its discoverer.

Ethiopian Bush Crow sports a conspicuous azure-blue patch of naked skin around the eye that is unusual for a corvid, but also found in the north-west African subspecies of Common Magpie *Pica pica mauritanica* though, perhaps surprisingly, Moltoni (1938) did not mention this in his discussion of the species' relationships. Benson (1946) threw doubt on the species' membership of the Corvidae as its Mallophaga were

atypical of corvids. Lowe (1949) remarked on idiosyncrasies in the palate structure and, because of this and other anatomical peculiarities placed the species in its own family Zavattariornidae. However, this was not generally accepted and, until recently, the species continued predominantly to be classified within the Corvidae. Fry *et al.* (2000) preferred to place it in the Sturnidae, emphasising anatomical characteristics in common with the Wattled Starling *Creatophora cinerea*. However, molecular analysis by Ericson *et al.* (2005) revealed that Ethiopian Bush Crow is indeed a corvid, its closest relatives being *Podoces*, *Ptilostomus* and *Pica*.

The species inhabits an extremely small area of c.4,600 km² in southern Ethiopia, the centre of which is circumscribed by the towns of Yabello, Arero and Mega. Remarkably little is known of its biology, the very small number of recent studies being predominantly concerned with its status and threats to the species, as well as habitat change (e.g. Hundessa 1991, Syvertsen & Dellelegn 1991, Collar *et al.* 1994, Borghesio & Giannetti 2005). The population is estimated at c.10,000–20,000 individuals, though no reliable studies exist. The species is listed as Endangered in the 2005 IUCN Red List (BirdLife International 2004, 2005). In 2005, I undertook ornithological observations in the Borana region and was able to collect new data on the biology of the species.

Study area and methodology

I visited the Derido area (c.15 km south of Yabello and easily reached from the latter, 04°46'N 38°10'E) from 13 February to 6 March 2005. The mean altitude of the region, at the foot of a massif reaching 2,365 m, is c.1,700 m. A narrow belt of *Acacia* spp. replaces the bush on the barren slopes. In turn, this is replaced by agricultural land in the flat lowlands (Fig. 1). Climate was dry until 26 February; thereafter there were some periods of heavy rainfall each day.

Observations lasting several hours were undertaken at all times of day and recorded. The total observation period was c.120 hours. Population densities were estimated by transects wherein, because of the openness of the terrain, it was possible to register observations up to 100 m either side of the transect (see Table 1 for more details). These were walked slowly. Photographs of the

bush crows, to record their behaviour, were taken with a digital camera with 12× digital zoom.

Results

External characteristics

One of the most remarkable features of Ethiopian Bush Crow is the blue patch of naked skin around the eye. This patch extends towards the base of the bill in a narrowing band (Fig. 2). It has a warty appearance and, around the eye, a single row of bristles that broaden into a mat of bristles at the base of the bill (Fig. 3). The crow is able to displace the feathers around and behind the eye, thereby exposing a naked, flesh-coloured triangle of skin (Fig. 4; see also photographs in Francis & Shirihai 1999). This results in the eye appearing to bulge, and the otherwise round iris is thereby vertically narrowed. This action was repeatedly observed when a bush crow approached the observer as close as 2 m side on. I concluded that it was intended as a threat. When aroused for other reasons, the gesture was observed in a more infrequent and less pronounced manner, for example when a bird was fed by its partner or during nest selection. Skin around the eye can also be contracted (Fig. 5), but this occurred relatively rarely and served to reinforce the effect of the gesture. The flesh-coloured triangle behind the eye was rarely if ever observed under other circumstances, such as when feeding or resting (Fig. 6).

Voice

Bush crows are very vocal and were usually detected by such means in the field. In addition to the common contact call *kej* and the equally common call sequence *kerr kerr kerr* . . . , six other vocalisations were identified and related to specific circumstances. However, their exact function is unclear. Some of the calls were very soft and could only be heard at close range. It is therefore possible that the actual repertoire comprises more calls than those described here:

- A single metallic *kej* is the most commonly heard call, being often uttered when searching for food on the ground and in flight (clearly a contact-call).
- A nasal, rapid *kerr kerr kerr* . . . , at a distance reminiscent of a Zebra Finch *Taeniopygia guttata* and often given in flight, especially when in flocks (common).

- A metallic *kaw, kaw, kaw* . . . was occasionally uttered during allofeeding between adults (uncommon).
- A rapid *how, how, how* . . . ; a rather quiet vocalisation uttered whilst foraging in flocks; its function is unclear (uncommon).
- Several single *quak* notes; a rather quiet vocalisation uttered whilst foraging in flocks; its function is unclear (uncommon).
- A single, very soft *guw*, often variably repeated at irregular intervals; a rather quiet vocalisation uttered whilst foraging in flocks, its function is unclear (uncommon).
- A single, deep *waw* given when rubbing bills together (uncommon).
- A single *keh*, reminiscent of the *kej* contact-call, but softer; uttered when two or more adults were nest building.

The Borana people refer to the Ethiopian Bush Crow as ‘Kaka’ or ‘Kake,’ which, according to villagers, is an onomatopoeic description of its call.

Habitat and population density

The occurrence of the bush crow in the Derido region is concentrated in certain areas within the relatively narrow *Acacia* belt at the foot of the mountains. Recorded densities are summarised in Table 1.

Acacia stands adjoining cultivated areas supported the highest densities of bush crows. Fields, particularly their edges, were frequently used for foraging. Nests were also found in isolated trees

and bushes on cultivated land, but were never far from *Acacia* stands. More intensively cultivated areas, without trees and shrubs, were unoccupied. In the extensive bush-land on the plain, bush crow flocks were observed only irregularly, in particular where loosely packed soil and open areas provided conditions conducive to foraging. The species was absent from the stony and bushy slopes of the foothills and from *Juniperus* forests at higher altitudes.

In addition to trees and bushes suitable for nest building, the decisive factor for bush crow presence appeared to be sufficient loosely packed soil for foraging. Such conditions were optimum in open *Acacia* stands used for cattle pasture and, to a lesser extent, at edges of cultivated fields. The small, hutted villages of the Borana were fully incorporated into the birds’ range (Fig. 7). The activity range of a breeding pair during the nest building period was c.2 ha.

Activity and roosting behaviour

Bush crows are mainly diurnal. Activity in the roost area was rare, and restricted to flights between the roosts in the crowns of acacias, usually between 5 minutes before and 10 minutes after sunset. Before complete darkness fell, the birds often changed their position in a tree uttering single contact-calls, *kej*, though they were generally quiet. As far as could be ascertained individuals roosted between 0.5 m and several metres apart, with no direct contact, even between birds that arrived at the roost in pairs. In one case, a flock of

Table 1. Transect counts
Tableau 1. Aperçu des transects

Transect number	1	2	3
Description	<i>Acacia</i> stand facing north with small villages and large areas of open pasture	<i>Acacia</i> stand adjoining extensively cultivated fields	Dense <i>Acacia</i> stand
Date	17 February 2005	18 February 2005	26 February 2005
Time	06.30–09.00	6.30–09.00	07.00–09.30
Transect length (m)*	1,970	925	1,600
Transect width (m)*	200	200	200
Area (km ² , rounded)	0.4	0.2	0.3
Groups counted	7	5	2
Individuals counted	34	23	4
Variation in group size	1–9	1–6	-
Individuals per group	4.9	4.9	2.0
Individuals per km ²	85	115	13

* GPS measurements

30 bush crows spent the night on two roost trees some 80 m apart with a large number of Superb Starlings *Lamprotornis superbus*. Birds were also observed roosting alone or in pairs. Trees used as roosts differed each night.

The first activity in the morning was registered c.10–15 minutes before sunrise. At sunrise, the birds were already searching for food or occupied with nest building. In one case, the first flight to a nest under construction occurred 17 minutes before sunrise.

During the day, birds were generally constantly active. Bush crows often searched for food even at midday. Short pauses were taken throughout the day for preening, which mostly occurred in small groups. Foraging continued until shortly before departing to the nocturnal roost.

Movement

On the ground, *Zavattariornis* mainly struts. After the start of the rainy season, with the associated massive occurrence of flying insects, bush crows were observed repeatedly making skilful flying jumps from the ground. They also moved with great agility within acacia trees, walking along the horizontal branches. Also, by hopping from branch to branch, they were able to manoeuvre from the lower branches of the tree to the crown. In flight, the legs were tucked into the undertail-coverts with the toes slightly bent so that they protruded from the plumage. The birds glided short distances from the crowns of acacias to the ground with wingbeats being used only to correct their direction and to land.

Plumage care and allopreening

Short phases of plumage care (usually 2–3 minutes, sometimes up to 15 minutes) occurred frequently between foraging bouts. Such activity often was undertaken in small groups with mutual preening between adults a regular occurrence (Fig. 8). Particular attention was paid to preening the chin, the area around the eyes and the base of the bill. Birds often actively demanded preening by presenting their throat to another bird, with ruffled head and throat feathers. This demand was usually met immediately. Interestingly, subsequent reciprocal care of the preening bird was never observed.

Sometimes more than two birds participated in allopreening. One was observed preening

another and itself being preened by a third. During nest construction, preening was often observed between the pair involved. Bills were also often whetted on branches, as was the blue eyepatch.

Foraging

The diet apparently consists mainly of arthropods. Pupae and larvae were excavated and removed from the soil with the bill. This was performed by hacking deep into the soil with the bill slightly opened. The birds sometimes took the earth-covered pupae to the nearest tree or bush where they held the prey in their claws to work on it with the bill. Bush crows were often observed searching for food under cattle dung. They did not turn the large cowpats over, but levered them up slightly with their bill, with their head on one side.

Additionally, insects such as Lepidoptera were collected from the ground or caught in the air following rain. Insects flying close to the ground were also chased on foot at a fast pace and with sudden changes of direction. Rotten branches were attacked, with the bill being used like a woodpecker, apparently in order to find arthropod larvae. A bush crow was also observed landing on the back of a Zebu cow to peck for food, probably parasites, but these were not directly observed.

Foraging occurred alone or in groups (Fig. 9). Only once was a dispute over food between bush crows observed, when one bird was seen attempting to take a large moth away whilst being chased by another bird. It finally succeeded in working on its prey and consumed it on the ground.

Preferred feeding areas were open sheep and cattle pastures between acacias, as well as ploughed fields. Dung heaps and rubbish dumps near villages were also visited (Fig. 10).

Group size, allofeeding, sexual behaviour and nest building

Ethiopian Bush Crows were often found in flocks of 2–6, sometimes 20 birds ($\times 4.8$, $n=24$), which searched for food. At times, these small flocks gathered into larger flocks of up to 30. These were usually only temporary associations, which rapidly disbanded, with loud contact-calls (*kef*). These gatherings, which were observed several times per day, apparently consisted of the members of neighbouring breeding groups (see below). Their function is unclear. Even the smaller groups lacked



a permanent composition. Singles or pairs gathered infrequently to search for food or to preen, and subsequently joined other birds.

Allofeeding between adults was frequent. The initiative was usually taken by the feeding bird. Some feeding birds flew from as far away as 30 m with a prey in their bill. The donor put the food directly into the other bird's bill by holding its head horizontally to one side so that the other bird could take the proffered food. The bird being fed depressed its body close to the ground and sometimes fluttered its wings (Fig. 11). Feeding calls were sometimes heard. Once an adult was observed begging consecutively from two different members of the group: it was fed by one but refused by the other. On another occasion, one bird waited next to another as the latter seemed

likely to secure prey which it did and subsequently fed the first bird.

Feeding sometimes developed into display. A bird was observed positioning itself in front the bird it had just fed, spreading its belly plumage and squatting slightly as if it was about to brood (Fig. 12). Subsequently it straightened, stretched its head steeply upwards, and finally tilted it backwards. The display was observed with apparent interest by the other bird but without any obvious reciprocal behaviour (Fig. 13). Once, the display was observed to take the form of a presentation of twigs: two birds were foraging together when one picked up a twig with its bill, went over to the other, and presented it. The other bird accepted the twig, but discarded it shortly afterwards. Both then continued searching for food.

Captions to plate on opposite page

Figure 1. The countryside near Derido, southern Ethiopia. The loosely packed soil of the pastures between the umbrella-form acacia was particularly favoured by the Ethiopian Bush Crow *Zavattariornis stresemanni* (K. Gedeon)

La campagne près de Derido, Ethiopie du sud. La couche de terre lâche des pâturages entre les acacias était particulièrement appréciée par le Corbin de Stresemann *Zavattariornis stresemanni* (K. Gedeon)

Figure 2. A notable characteristic of the Ethiopian Bush Crow *Zavattariornis stresemanni* is the naked, azure-blue skin-patch around the eye, which extends over the lores (K. Gedeon)

Une caractéristique importante du Corbin de Stresemann *Zavattariornis stresemanni* est la tache bleu-azuré de peau nue autour de l'œil, qui s'étend au-dessus des lores (K. Gedeon)

Figure 3. The eyes are surrounded by a single row of bristles that thicken towards the bill into a bristle mat (K. Gedeon)

Les yeux sont entourés d'une rangée de vibrisses qui s'épaissit vers le bec en une brosse (K. Gedeon)

Figure 4. The bush crow presents a naked flesh-coloured skin patch behind the eye, presumably as a threat gesture and when aroused. The feathers around and behind the eye are displaced which results in the eye appearing to bulge. The iris is vertically narrowed (K. Gedeon)

Le Corbin présente un triangle rosâtre de peau nue derrière l'œil, vraisemblablement comme un geste de menace et d'excitation. Les plumes autour et derrière l'œil sont

lissées, donnant l'impression d'un œil protubérant. L'iris est verticalement rétréci (K. Gedeon)

Figure 5. The skin around the eye can also be contracted, which emphasises the effect of the gesture (K. Gedeon)

La peau autour de l'œil peut également être contractée, accentuant l'effet du geste (K. Gedeon)

Figure 6. Usually, e.g. during foraging or when at rest, the flesh-coloured patch behind the eye is not or only scarcely noticeable. Note also the typical corvid ruffled 'trousers' (K. Gedeon)

Normalement, par exemple pendant la recherche de nourriture ou au repos, la tache rosâtre derrière l'œil n'est pas ou à peine visible. Noter également le 'pantalon' hérissé typique des corvidés (K. Gedeon)

Figure 7. Ethiopian Bush Crow *Zavattariornis stresemanni* also breeds in the centre of Borana villages and shows little fear of man. A nest from the previous year in the *Acacia* centre right, with the author's tent below it (K. Gedeon)

Le Corbin de Stresemann *Zavattariornis stresemanni* niche également au milieu de villages Borana et est peu farouche. Noter le nid de l'année précédente dans l'*Acacia* au centre-droit, avec la tente de l'auteur en dessous (K. Gedeon)

Figure 8. Allopreening. The bird on the right is moving closer and presents its ruffled head and throat plumage, inviting the other bird to preen (K. Gedeon)

Toilette mutuelle. L'oiseau de droite s'approche et présente ses plumes hérissées de la tête et la gorge, invitant l'autre oiseau à lui faire sa toilette (K. Gedeon)

Selection of the nest site is made in pairs or groups. In one case, initially four then three birds were involved. A twig is worked into the crown of an acacia and then tugged into place whilst those present raise a great clamour and show animated facial expressions (see External characteristics). The birds plucked green acacia leaves and held them in their bills for a while before letting them fall. They did the same demonstratively with twigs, earth and other fine materials before chasing one another, with the material in their bills, through the treetop. This activity was greatly ritualised and, at the time, clearly was unrelated with collecting material for the nest. Nest site selection was concluded after two days.

Bush crows remained in groups for the subsequent phases of nest building. Three to five pairs often constructed their nests within distances of 30–100 m of each other. However, it is difficult to designate these groups of nests as well-defined colonies, as neighbouring nests are often not far away, and it is unclear whether, and in what form, the birds are associated with neighbouring groups. The first rain of the season fell on 27 February and the previously somewhat hesitant nest building activity was greatly intensified next day. New nests were begun and existing nests from the previous year repaired (Fig. 14). Several birds were active at each nest, three birds being the rule, but at times up to six were present at a single nest, although not all were involved in the actual nest building. These latter birds, helpers or potential helpers, were usually tolerated. The reaction to pairs was different. On several occasions bush crow pairs were seen to chase a neighbouring pair through the treetops out of their nest area with loud *kerr-kerr* calls.

Two birds often brought nest material simultaneously. Such birds cooperated very intensively in nest building, and it is assumed that these were pairs. When one flew off with nest material, the other rapidly picked up a twig and followed to the nest. Twigs were gathered from within a radius of 150 m, and were taken from the ground or broken off from branches (Fig. 15). Wet clumps of soil were brought to the site at an early phase of nest building, clearly in order to fix the first twigs on the branch. Later, as well as twigs, cattle dung was also used. Whilst one bird constructed the nest, the partner and sometimes a helper often perched

in the immediate area. Allopreening and bill-rubbing occurred frequently on such occasions.

Some individuals, obviously helpers, assisted at different nests at the same time. Sometimes a bird attempted to add material to a nest, but then desisted and took the twig to another nest site c. 100 m away. It would appear that helpers are not permanently affiliated to a particular breeding pair. Another apparently remarkable observation was of two birds that had searched for food together for a long period. Finally, they both gathered nesting material and transported it to two different nests. They were obviously not a pair—which, from their behaviour, had been assumed at first— but two helpers.

Nests were constructed in the crowns of acacia trees or bushes at 2.5–10 m above ground. On the day of my departure, 6 March, none of the nests was complete and copulation was never observed.

Interspecific behaviour

Once I saw a bush crow attacking an African Harrier Hawk *Polyboroides typus* as it attempted to plunder the nest of a Wattled Starling. Augur Buzzards *Buteo augur* which flew over or perched in the immediate proximity were only registered by the bush crow with a short alarm-call, but otherwise ignored. A hunting Gabar Goshawk *Micronisus gabar*, which was pursued by a loudly calling Northern White-crowned Shrike *Eurocephalus rueppelli*, and which caused Superb Starlings to utter alarm-calls and take flight, was completely ignored. A White-bellied Go-away-bird *Criniferoides leucogaster* had its tail pulled by a bush crow, after the latter had deliberately positioned itself behind it in the branches. This was more of a 'playful' behavioural reaction, as otherwise the two species were indifferent to one another. Other passerines occasionally mobbed bush crows or followed them in flight (e.g. Fork-tailed Drongo *Dicrurus adsimilis* and Greater Blue-eared Glossy Starling *Lamprotornis chalybaeus*).

Bush crows were often seen foraging with the following species: Ring-necked Dove *Streptopelia capicola*, Red-billed Hornbill *Tockus erythrorhynchus*, Shelley's Starling *Lamprotornis shelleyi*, Wattled Starling, White-browed Sparrow Weaver *Plocepasser mahali*, Red-billed Buffalo Weaver *Bubalornis niger* and White-headed

Buffalo Weaver *Dinemellia dinemelli*. They did not seek the company of these species but met at abundant food sources such as village refuse dumps. A Red-billed Hornbill repeatedly tried to steal prey from a bush crow, but the latter prevented this by skilfully avoiding its pursuer. However, the hornbills had the upper hand when it came to occupying a productive foraging site. Bush crows did successfully drive Superb Starlings from presumably good food sources. Ethiopian Bush Crows, probably due to their constant proximity to villagers, show little fear of man with an escape-flight of only a few metres.

Discussion

The variety of social interaction is an impressive element of the Ethiopian Bush Crow's behavioural repertoire, in particular the frequency of allofeeding and allopreening. According to local villagers, the bird appears to occur in flocks year-round and helpers are involved in the breeding process. Such behaviour occurs to a differing degree among corvids and is especially marked in Florida Scrub Jay *Aphelocoma c. coerulescens* (Woolfenden & Fitzpatrick 1990). The present study describes, in rough outline, comparably intense and complex group behaviour in a further corvid species.

Little is still known as to the exact extent and importance of allofeeding in birds. In a similar study of Jackdaws *Corvus monedula*, Selvis *et al.* (2003) showed that such feeding is common. It is still unclear whether, in the case of *Zavattariornis*, allofeeding is restricted to displaying and breeding pairs (courtship feeding). My observations seem to indicate that this is not the case and that food is also offered to other birds in the flock. Allofeeding and allopreening remained, as far as could be observed, unreciprocated. The gain for the donor may perhaps consist in fidelity or an increase in social prestige within the flock. Mating prospects may therefore be improved (handicap principle: cf. Roberts 1998). Zahavi (2002) and Kalishov *et al.* (2004) interpret their findings for Arabian Babbler *Turdoides squamiceps* similarly. More detailed studies of the social system of Ethiopian Bush Crow would require marking of individual birds, genetic analysis and more advanced comprehensive field research, but is clearly desirable.

A study of the bush crow's individual forms of facial expression offers a further fascinating field of study. The exposure of skin patches around the eyes, and the apparently associated changes in the iris, are probably unique.

Within its restricted range, Ethiopian Bush Crow is patchily distributed, but it is still common in the Yabello region, where it can attain high densities locally. However, this region is currently undergoing a profound change. In the course of the last few years, the small settlement of Yabello has become an administrative centre of several thousand inhabitants and a continually expanding residential area. Ethiopian Bush Crow was observed at the edge of the urban area but is absent from the centre.

Even more serious is habitat loss due to the increase in cultivated areas. In Yabello, as in Derido, *Acacia* stands are being cleared on a large scale. This process has accelerated during recent years due to political and administrative intervention. Some 10–20 years ago cultivation was virtually unknown in the Borana area, where the local people were nomadic pastoralists. Pastures were communal and private ownership of land or the constitution of food stocks was unknown (Helland 1997). A partial change in farming practices to more maize cultivation is intended to develop a monetary economy and promote self-sufficiency and the constitution of food stocks. The consequences for the habitat and the social system of the Borana will be devastating (Homann 2004). The *Acacia* stands inhabited by *Zavattariornis* in the areas surrounding villages are particularly threatened. They grow mainly on loosely packed, relatively stone-free and deep soil strata which is particularly suitable for cultivation. This, together with a sharp increase in human population, will result in continued habitat loss for Ethiopian Bush Crow. The region around Yabello is a designated wildlife sanctuary and an Important Bird Area (Tilahun *et al.* 1996). Although tree clearance for use as firewood is prohibited, this is difficult to enforce and apparently does not apply to the cultivation of new areas. In February–March 2005 several slash-and-burn operations were observed (Fig. 16).

Borghesio & Giannetti (2005) document changes in the Ethiopian Bush Crow population



and the large-scale habitat change in its range since 1989. They estimate a decline in bush crow numbers for the period 1989–2003, based on roadside counts, at 80%. The authors suspect that, in addition to tree removal, the increasing transformation of open land to bush as a result of overgrazing by domestic stock, especially within the wildlife sanctuary, has led to a decline in bush crow numbers. The bush crow's preference for open areas (sparsely planted *Acacia* savanna) was confirmed by my study. Destruction of such areas, whether by clearance or transformation to bush, would have a negative effect on the bush crow population. The species' habitat cannot be extended by bush clearing in its primary locations of stony plains or slopes with a south-facing aspect, as soil conditions in these areas are unsuitable. Indeed, the crucial criterion is the presence of loosely packed deep soil with the bird's preferred prey (beetle larvae). This explains the concentration of bush crow breeding pairs in *Acacia* stands and the especially

high population density adjacent to freshly ploughed farmland. This is probably also the main reason why *Zavattariornis* inhabits such a small and well-defined area.

As with many other species, the future of the Ethiopian Bush Crow depends on a sustainable use of the land. The general deficits in and requirements for nature conservation in Ethiopia are well known, and have been listed in detail by the Biodiversity Support Programme (Jacobs & Schloeder 2001). The implementation of protection measures are however extremely difficult, not least because of the socio-economic situation in the country.

It is not only its comparatively recent discovery that makes the Ethiopian Bush Crow one of the most remarkable African birds. Its exceptionally interesting biology, and the acute threat to its habitat, should place it clearer than it has been to date in the focus of international research and conservation.

Captions to plate on opposite page

Figure 9. Small flocks of two to six birds (more seldom lone birds) are often seen searching for food (K. Gedeon)

De petits groupes de deux à six oiseaux (plus rarement des oiseaux solitaires) sont fréquemment observés recherchant de la nourriture (K. Gedeon)

Figure 10. Dung heaps and rubbish dumps (here maize cobs) around villages are inspected regularly (K. Gedeon)

Des tas de crottes et d'ordures (ici des épis de maïs) près des villages sont inspectés régulièrement (K. Gedeon)

Figure 11. Allofeeding. The bird being fed (on the right) cowers on the ground. The initiative to feed usually comes from the donor (K. Gedeon)

Nourrissage mutuel. L'oiseau se faisant nourrir (à droite) se tapit ou s'assied par terre. D'habitude l'initiative du nourrissage est pris par le donneur (K. Gedeon)

Figure 12. The display behaviour shown by the bird on the right was preceded by its feeding of the bird on the left. The donor cowers demonstratively before the other and spreads its belly-feathers as if brooding (K. Gedeon)

Le comportement de parade de l'oiseau à droite est précédé par son nourrissage de l'oiseau à gauche. Le donneur se tapit devant l'autre et écarte les plumes du ventre comme s'il allait commencer à couvrir (K. Gedeon)

Figure 13. Finally, the displaying bird straightens up, stretches its head upwards, and tilts it backwards. Its partner watches carefully throughout (K. Gedeon)

Enfin, l'oiseau paradant se redresse, allonge le cou et penche la tête vers l'arrière. Son partenaire l'observe attentivement pendant toute la procédure (K. Gedeon)

Figure 14. In some cases, new nests are built on top of old ones from previous years, so that large constructions are sometimes observed (K. Gedeon)

Dans certains cas, un nouveau nid est construit sur un ancien de l'année précédente, ce qui fait que de grosses constructions peuvent parfois être observées (K. Gedeon)

Figure 15. Besides twigs, earth and dung are used in the early stages of nest construction (K. Gedeon)

En dehors de brindilles, de la terre et des crottes sont utilisées dans les phases initiales de la construction du nid (K. Gedeon)

Figure 16. Habitat of Ethiopian Bush Crow *Zavattariornis stresemanni* is threatened in particular by the spread of cultivation. Stands of *Acacia* are often subject to slash-and-burn operations to make way for cultivated land. The photograph was taken in bush crow habitat south of Yabello (K. Gedeon)

L'habitat du Corbin de Stresemann *Zavattariornis stresemanni* est menacé particulièrement par l'expansion des terres cultivées. Des peuplements d'acacias sont souvent brûlés pour faire place aux cultures. La photo a été prise dans une zone du Corbin au sud de Yabello (K. Gedeon)

Acknowledgements

I thank the Borana Zone Administrative Council and the administration of the Yabello Wildlife Sanctuary for permitting my stay, the residents of Derido for their hospitality and Ali Guche (Yabello) for his invaluable assistance. Luca Borghesio provided extensive and valuable comments on the manuscript. Many thanks also to Stefan Fischer and Stephan Ernst for their helpful remarks, to John Ash and Nigel Collar for their constructive comments on the final draft, and to David Conlin for translating my manuscript to English.

References

- Benson, C. W. 1946. Notes on the birds of southern Abyssinia. *Ibis* 88: 180–205.
- BirdLife International 2004. Species factsheets: *Zavattariornis stresemanni*. <http://www.birdlife.org> (accessed 21 December 2004).
- BirdLife International 2005. Birds on the IUCN Red List. What's new 2005. <http://www.birdlife.org> (accessed 2 September 2005).
- Borghesio, L. & Giannetti, F. 2005. Habitat degradation threatens the survival of the Ethiopian bush crow *Zavattariornis stresemanni*. *Oryx* 39: 44–49.
- Collar, N. J., Crosby, M. J. & Stattersfield, A. J. 1994. *Birds to Watch 2: The World List of Threatened Birds*. Cambridge, UK: BirdLife International.
- Ericson, P. G. P., Jansen, A.-L., Johansson, U. S. & Ekman, J. 2005. Inter-generic relationships of the crows, jays, magpies and allied groups (Aves: Corvidae) based on nucleotide sequence data. *J. Avian Biol.* 36: 222–234.
- Francis J. & Shirihai, H. 1999. *Ethiopia. In Search of Endemic Birds*. Privately published.
- Fry, C. H., Keith, S. & Urban, E. K. (eds.) 2000. *The Birds of Africa*. Vol. 6. London, UK: Academic Press.
- Helland, J. 1997. Development interventions and pastoral dynamics in southern Ethiopia. In Hogg, R. (ed.) *Pastoralists, Ethnicity and the State in Ethiopia*. London, UK: Haan Publishing.
- Homann, S. 2004. *Indigenous Knowledge of Borana Pastoralists in Natural Resource Management: A Case Study from Southern Ethiopia*. Goettingen: Cuvillier Verlag.
- Hundessa, T. 1991. Survival status review of the Ethiopian Bushcrow (*Zavattariornis stresemanni* Moltoni, 1938) in the Borana area, Ethiopia. *Walia* 13: 9–13.
- Jacobs, M. J. & Schloeder, C. A. 2001. *Impacts of Conflict on Biodiversity and Protected Areas in Ethiopia*. Washington DC: World Wildlife Fund.
- Kalishov, A., Zahavi, A. & Zahavi, A. 2004. Allofeeding in Arabian Babbblers (*Turdoides squamiceps*). *J. Orn.* 146: 141–150.
- Lowe, P. R. 1949. On the position of the genus *Zavattariornis*. *Ibis* 91: 102–104.
- Moltoni, E. 1938. *Zavattariornis stresemanni* novum genus et nova species Corvidarum. *Orn. Monatsber.* 46: 80–83.
- Roberts, G. 1998. Competitive altruism: from reciprocity to the handicap principle. *Proc. Roy. Soc. Lond. Ser. B* 265: 427–431.
- Selvis, R. de K., Emery, N. J. & Clayton, N. S. 2003. Food offering in Jackdaws (*Corvus monedula*). *Naturwissenschaften* 90: 238–240.
- Syvrtsen, P. O. & Dellelegn, Y. 1991. The status of some bird species in south Ethiopia. *Scopus* 15: 30–34.
- Tilahun, S., Edwards, S. & Egziabher T. B. G. (eds.) 1996. *Important Bird Areas of Ethiopia*. Addis Ababa: Ethiopian Wildlife & Natural History Society.
- Woolfenden, G. E. & Fitzpatrick, J. W. 1990. Florida Scrub Jays. A synopsis after 18 years of study. In Stacey P. B. & Koenig, W. D. (eds.) *Cooperative Breeding in Birds*. Cambridge, UK: Cambridge University Press.
- Zahavi, A. 2002. Indirect selection and individual selection in sociobiology: my personal views on theories of social behaviour. *Animal Behav.* 65: 859–863.
- Landesamt für Umweltschutz Sachsen-Anhalt, Fachgebiet Tierartenschutz und Staatliche Vogelschutzwarte, D-06116 Halle (Saale), Germany. E-mail: k.gedeon@web.de

Received 20 September 2005; revision accepted 16 May 2006